



PORTLAND HARBOR RI/FS

Round 3A FIELD SAMPLING PLAN
STORMWATER SAMPLING

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January 24, 2007

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Stormwater Sampling
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Appendix G Laboratory Protocol for Extraction and Analysis of Large Volume Water
Samples
~~Appendix H QAPP Addendum~~
Appendix ~~H~~ Confined Space Health and Safety Plan Addendum

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1.0 INTRODUCTION

This stormwater Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in early 2007 for the Remedial Investigation/Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). The RI/FS project is currently conducting Round 3A of sampling for various purposes in the river, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling. This FSP describes the field sampling and laboratory analysis procedures to accomplish the following types of data collection:

- sStormwater chemistry, tTotal sSuspended sSolids (TSS), and associated conventionals; and
- Sstormwater sediment chemistry and associated conventionals; and stormwater runoff volumes.

The field study approach, sampling methods, and analyses for stormwater ~~sampling~~ are described in this document.

1.1- BACKGROUND AND CONTEXT

The stormwater investigation approach presented here is based on the December 13, 2006 memorandum (Koch et al. 2006) from the U.S. Environmental Protection Agency (EPA) assigned sStormwater tTechnical tTeam for the RI/FS as well as notes from a Portland Harbor managers¹ meeting where the memorandum was discussed on December 20, 2006. The technical team included representatives from members of EPA, Oregon Department of Environmental Quality (DEQ), and the Lower Willamette Group (LWG).

The memorandum was the result of detailed discussions of the Stormwater Technical Team conducted in late 2005. The team was convened because it was determined by EPA and LWG that stormwater data were needed to complete the RI/FS, and that such data would have to be collected in the 2006/2007 rainy season to fit within the overall RI/FS project schedule. The timing of this decision allowed a very short time for identification of data needs and a desired sampling framework, which was developed by the Stormwater Technical Team and approved by the Portland Harbor managers by the end of 2006. These timing issues also limited the scope, extent, and methods of stormwater data collection that could be completed by the end of the 2006/2007 rainy season and considered within the framework. For example, actual data collection can only occur over the later portion of this rainy season and sampling of storm events over several rainy seasons is not feasible.

Given these timing limitations, the Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and selected the ones described in this

¹ Portland Harbor managers include project managers from EPA, DEQ, and LWG.

document based on (1) the ability to meet the objectives for data use (described below) as agreed by the Portland Harbor managers and (2) practicability in terms of schedule, cost, and feasibility.

When using data generated from this FSP for modeling or other estimation tools, it is important to keep in mind the above limitations. Both the small number of storm events sampled (three events³) and the limited timeframe for collecting samples (February through May of a single water year) need to be considered when extrapolating from this data to estimate average annual contaminant loads to the river.

While these discussions were ongoing, the Port of Portland was simultaneously (and continues) implementing an evaluation of potential stormwater sources and impacts at the T-4 Terminal 4 site within the Portland Harbor, where an early action sediment clean up is currently being designed under a separate EPA-approved work plan. The T-4 Terminal 4 stormwater work is intended to address all of the objectives for this FSP as discussed below. Consequently, the Port volunteered to include these T-4 Terminal 4 sites within the overall RI/FS stormwater investigation and adjust this work to be as consistent as possible with the approach described in this FSP. Because the T-4 Terminal 4 work is on-going, there may be minor differences in implementation details; however, the overall approaches and scope are consistent.

1.2 SAMPLING PURPOSE AND OBJECTIVES

The purpose of this sampling and analysis effort is to provide data for evaluating the potential risk and sediment recontamination threat from stormwater discharges to the river. These data will be used for understanding the magnitude of stormwater impacts to the harbor, developing the draft in-river Site RI, identifying stormwater data gaps, and eventually, for evaluating remedial alternatives in the Site FS.

The objectives of the stormwater sampling program were developed in coordination with EPA, DEQ, and the LWG. These objectives are defined as:

- EPA/LWG RI/FS Objectives
 1. Understand stormwater contribution to in-river fish tissue chemical burdens.
 2. Determine the potential for recontamination of sediment (after cleanup) from stormwater inputs.
- DEQ/City of Portland/DEQ Upland Source Control Objectives
 1. Evaluate stormwater discharges to identify potentially significant hazardous substances that could reach the river.
 4. Identify, prioritize, and control stormwater sources as necessary to prevent contamination of Willamette River water and sediments and recontamination of river sediments following the Portland Harbor cleanup. Determine stormwater sources that now contribute (or could in the future) unacceptably to risks in the river (in terms of direct water or sediment toxicity or bioaccumulation).

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2. ~~Identify and control sources and estimate stormwater contributions to in-river risk after controls.~~

The primary focus of this FSP is to obtain data that meet RI/FS objectives, and the Technical Team devised a sampling framework with this intent. However, the team also considered techniques and approaches that could feasibly provide potential overlapping data uses to help meet Source Control Objectives.

It should be noted that in addition to the stormwater data collection described in this FSP, DEQ is pursuing collection of stormwater data at a number of Portland Harbor sites as a part of the Joint Source Control Strategy (JSCS) to meet the above source control objective. ~~The City of Portland is also collecting some stormwater data are also being collected under stormwater data for various purposes related to stormwater source control.~~ National Pollutant Discharge Elimination System (NPDES) permittees in Portland Harbor. As these data become available, they will be used wherever possible and technically defensible to augment the estimations of stormwater loads based on data collected as described in this FSP to help meet the above RI/FS objectives.

The RI/FS objectives as they relate to this FSP are discussed in more detail below.

1.2.1 Stormwater Contribution to Fish Tissue Burdens

Surface water chemicals are suspected to contribute to fish tissue burdens (and related risks) in the harbor. The importance of various sources of surface water chemicals, particularly stormwater, is not well understood. This lack of understanding could make it difficult to accurately determine sediment (and water) preliminary remediation goals (PRGs) that are intended to minimize fish tissue related risks for the Site.

Thus, it is necessary to determine the relative contribution of stormwater (as compared to other sources) to surface water concentrations of selected chemicals. As noted above, this would be done for stormwater in terms of loading estimates. ~~Thus, to understand the relative stormwater's contribution of stormwater chemicals to fish tissue burdens other sources of chemicals also need to be understood. Other potentially important other sources to the water column and fish tissue that are currently being investigated by the LWG are contributions from upstream and from in-river sediment chemicals, similar data needs exist for other sources and are addressed elsewhere in RI/FS planning and reporting documents.~~

1.2.2 Stormwater Contribution to Recontamination Potential ~~Evaluation~~

~~Surface stormwater discharges have the potential to chemicals may~~ contribute to recontamination of ~~remediated~~ sediments near outfalls (and/or potentially ~~widespread harbor-wide~~ for some chemicals) after cleanup has been completed, if the discharges contain contaminants attached to settling solids. The potential for this outcome must be

assessed at an FS-appropriate level of detail to understand the general extent and need for stormwater source controls. ~~at least on a regional basis within the site.~~

To predict whether sediments would recontaminate at levels above PRGs eventually set for the site, estimates of stormwater loads ~~by outfall (or at least region segment)~~ are needed for input into estimation tools and models described in Section 1.4. These load estimates must be on a spatial scale consistent with those estimation tools and models. The load estimates should be accompanied by sufficient site-specific measures to assist in the estimation of chemical mass associated with particulates (that may settle to the sediment bed) versus dissolved mass. ~~This requires estimates of loads by modeling segment (as described by Hope 2006) of the river. Estimates of the mass of chemicals present in particulate forms to support Fate and Transport modeling predictions of inputs to and eventual concentrations of chemicals in sediments are also needed.~~

1.3.2 SUMMARY STORMWATER SAMPLING APPROACH

This FSP describes the approach for measuring the concentrations of chemicals in stormwater and for obtaining stormwater flow data at 31 select locations in the Site to meet the above objectives for directly estimating stormwater loads and extrapolation of loads to other unsampled outfalls or modeled river segments. ~~These data will be used, in conjunction with estimation and evaluation tools described below, to assess the nature and extent of chemical loading from stormwater discharges to the site.~~ In summary, the sampling approach ~~at each of these select outfalls drainage basins involves determined by the technical team is:~~

1. Flow-weighted composite water samples from three storm events including whole water for organic compound analyses and filtered/unfiltered pairs for metals analyses.
2. ~~Additional~~ One additional set of grab stormwater samples at 10 of the 31 sampling locations for sampling of filtered/unfiltered pairs and analysis of selected organic compounds.
3. Sediment trap deployment and sampling for a minimum duration of three 3 months.
4. Continuous flow monitoring at each sampling site for the duration of the sampling effort ~~sediment trap deployment period.~~

The rationale for this sampling approach to meet RI/FS objectives and details of each element of the approach is described in more detail in the remainder of this document.

1.4 DATA USE AND SAMPLING RATIONALE

Several estimation and evaluation methods and tools will use the collected data to be used ~~meet the above objectives these assessments. The data needs of these tools were considered to help define the type and quantities of data to be collected.~~ The modeling tool of primary consideration is EPA's Fate and Transport Model described by Hope (2006). This tool is being used by DEQ to help identify and prioritize the ~~identify~~ understand ~~s~~ stormwater sources that may require ~~sources~~ inputs and needed ~~source~~ control measures. It is also being used by EPA/LWG in combination with the LWG-developed in-river Hydrodynamic and Sedimentation Model (West 2005) to directly evaluate the RI/FS objectives above-discussed in the next subsection. In summary, these models require estimates of the data input in terms of chemical mass load (e.g., kg/yr) from each type of contaminant source (e.g., stormwater, groundwater, upstream, etc.) for each of the source estimated along model-defined segments of the river. For stormwater, a chemical mass "load" per unit time (e.g., kg/yr) is needed for each river segment of the model.

In general, to estimate stormwater loads, a chemical concentration in stormwater and the volume of stormwater discharge (i.e., time-integrated flows) must be known. These terms in the loading equation can be either directly measured (the subject of this FSP) or estimated through indirect means (e.g., runoff modeling of stormwater volumes). The following subsections briefly describe how loading estimates will be made using the data collected through this FSP.

1.4.1 Locations

Because of the large number of outfalls present at the Site, it was determined by the ~~technical team~~ that sampling of every outfall was infeasible to calculate the needed Site-wide stormwater chemical loads. Consequently, it was decided by the Stormwater Technical Team that a three-pronged approach would be used to balance the need for stormwater data at numerous locations with the feasibility and cost of data collection it on and thus, a subset of outfalls, as described drainage basins, as described in more detail below, will be sampled for stormwater chemistry and flows. Based on how data will be used in the Site-wide stormwater loading estimates, these basins fall into the following categories:

- Industrial locations with unique or unusual potential chemical sources that cannot be easily extrapolated from generalized land use measurements.
- Locations selected as representative of certain types of land use within the overall drainage area as follows²:
 - Residential

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² Note another kind of land use commonly evaluated in stormwater investigations is the "commercial" category, but this is a very minor use within the overall drainage and was judged not to warrant a specific sampling location.

- Major transportation corridors
- Heavy industrial
- Light industrial
- Open space
- Locations selected to directly measure stormwater discharge from relatively large basins that have a mixture of actual land uses and activities within them.

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Data from the first category of locations will be used to directly measure chemical sources at these industrial sites and will not generally be used to extrapolate loadings to other locations or general types of land uses. A primary issue that should be considered when selecting sampling locations is that industrial land uses tend to have relatively high loading rates and can have relatively unique chemical characteristics depending on the particular industrial activities taking place. This results in a high degree of variability in stormwater contaminant concentrations for this land use. Thus, extrapolation of generalized "industrial" loading rates to specific industrial sites may be highly uncertain and could greatly under or overestimate the actual loading from a particular industrial site. For example, extrapolation of polycyclic aromatic hydrocarbon (PAH) loads from general industrial storage type facilities to a former Manufactured Gas Plant site would be problematic. To address this issue, a higher proportion of sampling locations represent the industrial land use and some sampling locations with specific and/or unique conditions associated with particular industrial activities within the overall Site drainage areas have also been included. In some cases, the unique character of an industrial site may only apply to a certain type of chemical (e.g., metals from the Schnitzer metals handling facility) and other chemicals measured from this site might be used to make loading estimates for general land use categories (e.g., heavy industrial). In general, the data reduction approach is expected to entail pooling the data for each parameter (TSS, water chemical concentration, and sediment chemical concentration), removing the high outlier data (i.e., unique sites) and using the remainder to generate a heavy industry value for use in extrapolation to non-sampled heavy industry areas. Thus, the Industrial category sites should not be viewed as exclusively useful only to directly measure concentrations from these particular sites and may have wider application to the study.

The second category of locations will be combined to make estimates that are intended to be representative of land use categories and will be used in loading estimates for other unsampled areas with the same land uses. This is a commonly used and accepted approach in the field of stormwater management (Schueler 1987). Thus, the land use characteristics of the overall drainage basin for the Site should be described, and to the extent possible, sampling locations that isolate and measure runoff from specific types of land uses should be selected. In general, the greater the proportion of each land use within the overall drainage area, the greater the proportion of sampling locations that should be assigned to that land use. The primary land uses within the overall Site

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drainage basin, in descending order of total acreage are: parks/open space (e.g., Forest Park), industrial, and residential. The remainder of the drainage areas ~~are~~ composed of mixed land use (e.g., combinations of residential, commercial, and/or industrial), major transportation corridors (e.g., Highway 30 and Interstate 5), and commercial (e.g., shopping areas). Using the land use based extrapolation method, stormwater chemical concentrations measured from (for example) residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads based on the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for these land uses across the entire Site that can be input into the fate and transport model and other estimation tools.

The third category of locations will not be used in land use loading estimates because these locations measure a variety of land uses in one sample. These results will be used as a independent cross-check of extrapolated loads obtained from the second category of land use based estimates for these basins to understand the potential differences between the two methods and uncertainties in the overall approach (i.e., changes between land use locations and discharge to the river, potential for additional sources) to support model input decisions.

The loading estimates for the entire drainage will be obtained by combining information from the first two categories but not the last category. The land use extrapolated estimates are a general representation or "average" estimate of the potential loads from these types of land use. This approach can be inaccurate if substantial unknown unusual conditions lay within any of the unsampled areas. Also, there are limitations to using such data on a small scale since "averages" do not capture the variability that can occur within the overall landscape.

~~—The data from this subset of outfalls from these sampling locations will be used to extrapolate loading to other outfalls and/or model segments. Most sampling sites were selected to be representative of particular kinds of land uses.~~

~~For example, stormwater chemical concentrations measured from residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads based on the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for the entire Site that can be input into the fate and transport model and other estimation tools.~~—The exact methodology for using measured data and extrapolating chemical and/or flows data to unsampled outfalls or model segments for RI/FS purposes is the subject of ongoing discussions between EPA, DEQ, and the LWG.

1.4.2 Measurement Methods

As noted above, water samples and stormwater sediment samples will be collected. These two measurements will provide two independent means of estimating stormwater loads. For whole water chemical concentrations (mass chemical/volume water), these

values are multiplied by the volume of water discharging at the location over a set time to yield a load in mass/time. For sediment chemical concentrations (mass chemical/chemical/mass sediment), these values are multiplied by ~~Total Suspended Sediment (TSS)~~ concentrations (mass sediment/volume water) measured in water samples to yield a chemical concentration in water (mass chemical/volume water). This water chemical concentration can then be used to estimate loads identically as described for directly measured water chemical concentrations.

It is anticipated that these two methods will result in different predictions of mass loading at most sites. The reason for having two independent methods to estimate loads is that each method has some intrinsic measurement artifacts that will lead to varying load estimates. The advantages and disadvantages of each method are to some extent complimentary. By combining the two approaches, the disadvantages of each method can be better understood and the two loading estimates compared to provide a better overall sense of the potential range of chemical loads.

The primary advantage of stormwater sampling is that it provides a direct measure of the chemical concentrations in the water that can be converted to a load in one step (multiplication by volume discharged over a unit time). The disadvantage of stormwater sampling is that it captures one relatively small condition in time. Stormwater chemical concentrations are known to be widely variable depending on a variety of factors such as:

- ~~†~~The specific chemical sources within the drainage basin, which may vary over time and location within the basin
- ~~†~~The characteristics of the storms and their associated runoff (i.e., antecedent dry periods; storm amounts, intensity, and durations; stormwater collection system characteristics; and presence, condition and proper functioning of source controls)
- ~~h~~How and where stormwater is sampled
- ~~w~~When in the storm the samples are collected (i.e., first flush, rising limb, falling limb, etc.);

Ideally, estimation of long-term loads would involve a large number of water samples taken over the course of many years and many types of storms, pollutant sources, and runoff conditions. However, such an approach is rarely acceptable in terms of schedule or budget and is infeasible for this project. Consequently, methods that integrate, average, or estimate long-term chemical concentrations and flows over time are preferred. For this reason, water sampling for this project will be conducted using composite sampling techniques, where a large portion of a runoff event is sampled, rather than one or two grab samples within that runoff event.

The advantage of sediment traps is that they integrate the particulate associated chemical loading over time and avoid the need for large numbers of water chemistry samples. The disadvantage of sediment traps is that (1) they do not estimate the dissolved load and (2) they may preferentially capture only portions of the particulate load (e.g., coarser TSS fractions). Thus, they provide a much less direct measurement of the overall load that may be present in the stormwater being discharged.

1.4.3 Flow Information

Each of the various methods of estimating loads discussed above require some estimate of the volume of water discharged over unit time, which is defined as flow. Flow information will be collected at each location during the duration of the sampling effort. However, the primary use of this flow information will not be in the calculation of stormwater chemicals loads because:

- †The period measured is only a portion of the year and loads will need to be estimated on an annual basis
- †There will be insufficient time to calibrate flow measurements at each location to arrive at an accurate measurement of flows over the period measured.

The primary purpose of the flow measurements will be to assist in the composite sampling of stormwater on a flow-weighted basis. Flow weighted composite methods are described more below. In summary, the amount of sample taken is proportional to the flow of water present over the time period the sample is intended to represent. Each sample is then combined so that the composite sample is “weighted” based on the flow.

Volumes of water for use in loading estimates will be estimated by independent methods currently being discussed by the Stormwater Technical Team. In general, average annual volumes of discharge for each sampling location will be estimated using runoff estimation and modeling tools that are commonly applied to stormwater loading and conveyance system design.

1.4.4 –Other Considered Measurements and Conditions

Some other techniques and conditions were considered in the sampling design but not selected, and the reasons for such selections, are discussed briefly below.

Sediment traps were selected as the method to measure chemical concentrations on stormwater particulates. Other methods exist to obtain sediment samples such as pumping and filtering large amounts of stormwater and analyzing the solids captured by the filter (and similar methods of capturing particulates in water). Sediment traps were preferred because they are logistically simple to implement and passively capture

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sediment over a long period and wide range of conditions. By comparison, active filtering or capturing techniques are labor intensive and sample over a relatively short period of time, such as hours or perhaps a few days, and thus, have the same time integration limitations as composite stormwater sampling. However, high volume water filtering techniques will be employed if sediment trap deployment is infeasible (e.g., due to space limitations) and are described as a contingency method within this FSP.

The Stormwater Technical Team determined that TSS should be measured in stormwater to support the loading calculations based on sediment trap data as described above. Various methods exist for measuring particulates in stormwater including Suspended Sediment Concentration (SSC) methods developed by the U.S. Geological Survey (USGS). The SSC is reported by the USGS to provide a more accurate determination of the suspended sediment mass in water samples than TSS (Gray et al. 2000). However, TSS method is much more widely used and any historical data sets available for the sampling locations will likely be in the form of TSS. Because this historical information may be valuable in better estimating the range of suspended sediment conditions that might apply to estimates of chemical loads using sediment trap data, it appeared more important to collect any additional suspended sediment data for this program by a consistent means. Consequently, it was determined that the biases introduced by the TSS method are not so great as to warrant the inability to compare historical and new data sets.

The Stormwater Technical Team determined that three composite storm events would be sampled at each location. Greater and lesser numbers of events were considered. Given the time limitations of the study, three events appeared to represent a good balance between the preference for as many stormwater samples as possible to address the variability issues discussed above, the allowable timeframe for the sampling, ~~and~~ the number of appropriate storms that would occur in that period, and costs.

1.35 DOCUMENT ORGANIZATION

The remaining sections of this document describe the sampling plan and field procedures that will be used to collect stormwater and sediment samples:

- Section 2 describes the sampling design and rationale.
- Section 3 summarizes stormwater sample collection, processing, and measurement procedures for stormwater samples, sediment samples, and stormwater flows.
- Section 4 describes the sampling implementation and schedule including contingency procedures that may be employed to collect data.
- Section 5 summarizes how the data will be reported.
- Section 6 provides references.

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Detailed standard operating procedures (SOPs) for sampling and flow measurements are provided in appendices. The appendices also contain a Chain of Custody SOP, field sampling forms, and health and safety procedures and are organized as follows:

- Appendix A Stormwater Composite Sampling SOP
- Appendix B Stormwater Grab Sampling SOP
- Appendix C-1 Sediment Trap Sampling SOP
- Appendix C-2 Stormwater Filtering for Sediment Collection (Back Up Procedure)
- Appendix D Flow Meter Measurements
- Appendix E Field Forms
- Appendix F Chain of Custody SOP
- Appendix G Laboratory Protocol for Extraction and Analysis of Large Volume Water Samples
- ~~Appendix H QAPP Addendum~~
- Appendix ~~H~~ [Health and Safety Plan](#) [Confined Space Health and Safety Plan Addendum](#)

2.0 SAMPLING DESIGN AND RATIONALE

Section 1 describes the general approach and rationale for the overall study to support RI/FS objectives described in this FSP. This section describes some additional factors in the rationale for the stormwater sampling design that will support the RI/FS objectives.

2.1 DATA NEEDS

Existing stormwater quality data for the Site are sporadic and relatively limited (Integral et al. 2004). Consequently, estimation of stormwater loads to the river based on existing data or literature values would be difficult and highly uncertain. Site-specific and land use-based stormwater sampling is needed to support stormwater chemical loading estimates for input into the fate and transport model and other estimation tools that will be used to assess the two RI/FS objectives as noted in Section 1.

2.1.1 Sampling Locations

The development of sampling locations based on land use and other drainage area activities is described in Section 1. In addition, to these factors, Finally, because the overall purpose of the sampling is to calculate loads for the siteSite, it worth consideringis important to optimizinge sampling locations to minimize the amount of extrapolation based on land use. Although all outfalls cannot be directly sampled, the number of outfalls that need to be extrapolated from indirect information can be minimizedshould be minimized where possible, by in favor of directly measuring loads. That is, directly measured data is preferred over extrapolated data, when a feasible choice can be made. Consequently, preference was should be given to sampling locations as close to the outfall discharge point as possible, while taking into account any physical limitations, and maintaining the approach of isolating certain land uses within a reasonable subset of the sampling locations. Similarly, where one location at or near a large basin's discharge point can be sampled, this would be preferred to extrapolating loads based on land use from many other sampling points outside the basin. The smaller the basin, the less feasible this preference becomes unless the number of sampling locations is to become very large. Consequently, application of this preference should be reserved for basins that represent at least several percent of the overall drainage basin for the site.

2.1.2 Sampling Types

Each measurement method selected should be fully evaluated to understand any types of supporting information that are needed to allow calculation of a long term load. One important supporting measurement will be TSS data in water samples. These TSS data will be needed to calculate chemical concentrations in water from sediment trap data. In this calculation, TSS (mass sediment/volume water) is multiplied by sediment trap chemical concentrations (chemical mass/mass sediment) to obtain a concentration

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~~associated with suspended sediments in water (chemical mass on sediments/volume water). This water concentration can then be multiplied by the volume of water discharged over some period to obtain a mass load exactly like to compare to calculations based on direct measurements of water chemical concentrations (after appropriately taking into account estimated loads associated with the dissolved fraction). Section 1 describes the general rationale for selecting both stormwater and sediment trap sampling techniques in the estimation of loads.~~

~~In addition to these general factors, In addition, in~~ information on grain sizes in sediment traps ~~may~~~~would~~ be useful in understanding the potential for particulate associated stormwater pollutants to settle and recontaminate ~~sediment near outfalls river sediments.~~ However, these data cannot be collected in preference to chemical concentrations without jeopardizing the ability to analyze all chemicals of interest, due to expected sediment sample volume limitations. Because of these logistical considerations, grain size data will likely be obtained for only a subset of sediment samples collected.

Also, the assumptions and calculation methods behind modeling tools that the data will be input to should be fully understood and evaluated to ensure that any ancillary data needed for these tools is collected. One particular data need of this type that has been identified is collection of filtered and unfiltered stormwater samples to help validate the partitioning algorithms used in the fate and transport model and other estimation tools. Such samples will be collected at all sampling locations and analyzed for metals on the analyte list, because site-specific metals partitioning is difficult to predict based on literature information. In addition, limited grab sampling of filtered/unfiltered water will be conducted at a subset of sampling locations and analyzed for organic compounds to provide ~~some~~ information on the range of partitioning characteristics for these chemicals. The partitioning of organic compounds is generally more predictable based on literature information, but some limited data collection for organic compounds will help validate these predictions.

2.2 SAMPLING LOCATIONS

Based on the identified data needs, the sampling locations in Table 2-1 were selected and are shown in Figure 2-1. The locations are broken down into several categories in Table 2-1 that reflect the data needs discussed above and the negotiation process of the Stormwater Technical Team:

- Industrial locations (~~121~~) that may have unique chemical loads
- Land ~~Use-based~~~~and General Urban~~ locations (~~121~~)
- ~~o Locations targeting specific isolated land uses (9)~~
- Locations targeting ~~large~~-basins with ~~mixed urban~~multiple land uses (~~32~~)

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- ~~T-4~~Terminal 4 Recontamination Study locations (7) representing a range of sites that represent both land use based both isolated land uses and relatively unique industrial sites.

With respect to data needs, the “land use-based” ~~outfalls~~sampling locations are generally those that are targeting particular types of land uses, and data from these sites will be used to extrapolate to other unsampled areas. As discussed in Section 1.1, locations at outfalls OF-17, OF-19, and M-1 represent large basins with relatively multiple mixed land uses and will likely (e.g., outfalls OF-17 and OF-19) will not be used in extrapolations of land use based loading rates, but rather represent a direct measurement of a substantial portion of the overall drainage basin to the Site to compare with measured concentrations of isolated land uses and assess uncertainties within the overall approach. (i.e., changes between land use locations and discharge to the river, potential for additional sources (for sediment trap data)) to support model input decisions.

The ~~Industrial~~ sites reflect those locations that generally fulfill data needs for sampling of specific or unique industrial activities and mostly fall into the land use category of “heavy industrial.” As noted in Section 1.1, in some cases, chemical signatures from these locations will not be specific to the activities at the site, and these data may be useable for both site loading evaluation and extrapolation to a generalized heavy industrial loading rate for some chemicals where those chemical signatures are not unique to the activities on the site. For example, PAH concentrations at the Schnitzer location(s) may be representative of general heavy industrial conditions, while the metals concentrations are likely not.

Finally, there are seven locations identified associated with the Port of Portland’s ~~T-4~~Terminal 4 sampling effort, which is ongoing. This sampling is subject to a separate agency approved work plan and has been designed to meet all four objectives described in Section 1.1 (i.e., including source identification). While some of the implementation details of the T-4 Terminal 4 are slightly different than described in this plan FSP, the overall sampling approach is the same (sediment traps, sampling of three storm events with total and dissolved analyses) and the data generated will be consistent with those generated at other locations. The Port has agreed to adapt this program to follow the approach defined in this FSP. Data from these locations will be used similar to that described above for “land use-based” locations using the categories identified in Table 2-1. However, the data from heavy industrial type locations will be evaluated to determine if any of these locations exhibit unique or particular chemical signatures related to specific industrial activities on these sites. If so, data from these locations may be more properly evaluated similar to the high priority sites, where only some locations or chemicals are used in the land use based extrapolations to Site-wide loads.

2.3 SAMPLE TYPES AND NUMBERS

Table 2-2 summarizes the proposed stormwater sampling types, numbers, and analyses. Table 2-3 summarizes the priority order of sampling of analytes for each sample type and the approximate sample volumes that will be needed for these analyses. The analytical concentration ~~goals achievable with these sample volumes is~~ goals achievable with these sample volumes are discussed more below. Three types of measurements will be conducted each station:

Stormwater Composite Samples. Flow-weighted composite samples of ~~three~~ 3 storm events from each location will be collected to obtain Event Mean Concentrations (EMCs) of ~~constituents of interest~~ COs. Flow-weighted, whole water (unfiltered) sample aliquots will be collected ~~with ISCO Model 6712~~ over the course of the storm event with automatic samplers. These whole water samples will be collected by the sampling teams, identified in Section 4, and transported to the LWG Field Laboratory. At the LWG Field Laboratory, ~~these samples will be composited~~ sampler performance will be evaluated and the water from the individual sample bottles will be combined and mixed in a single container. Whole water samples for organic compounds, and unfiltered/filtered water pairs will be prepared for metals and total organic carbon (TOC)/dissolved organic carbon (DOC) by the sampling teams from the combined composite sample. ~~Samples~~ will also be prepared for analysis of TSS concentrations. Each sample will be analyzed for the chemicals shown in Tables 2-2 and 2-2-3. In addition, the priority order and list of chemicals analyzed will vary somewhat between locations as shown in Table 2-4a for reasons discussed below.

~~o~~ Organochlorine pesticides will be analyzed in composite water samples at the following sites given their potential source histories:

- WR-96 – Arkema
- ~~WR 22B – Front Ave. Props.~~
- ~~WR 6 – Rhone-Poulenc~~ OF-22B – Chemical manufacturing
- WR-6 – Rhone-Poulenc

Only a subset of sites will be analyzed for phthalates because of the logistical difficulties of avoiding phthalate contamination from field sampling equipment and laboratory analysis. Through Technical Team discussions, it was determined that it was appropriate to analyze for phthalates at those locations where there was a reasonable potential for phthalate related in-river risks that might be linked to upland sources. In addition, as a cross check on the assumptions behind potential phthalate sources, analyses should also be conducted for some locations that were not known or suspected phthalate sources. The preliminary risk evaluations currently underway by the LWG were reviewed for potential phthalate related risks near any of the proposed stormwater sampling locations. The following list of sites for phthalate analyses containing both potential and unlikely sources of phthalates was determined from the above research: The following 7 potential phthalate source locations were identified and are recommended for phthalate analyses:

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- WR-24 – Oregon Steel Mills
- WR-121/123 – Schnitzer
- WR-96 – Arkema
- WR-161 – Portland Shipyard
- WR-145 – Gunderson
- WR-148 – Gunderson (former Schnitzer)
- ~~In addition, the following 5 locations represent a cross-section of land uses that are not known or suspected phthalate sources and should also be analyzed for phthalates:~~
- ~~WR-161 – Portland Shipyard (Heavy Industrial)~~
- ~~OF-17 – City Mixed Use Basin~~
- ~~OF12a – Freemont Bridge To Be Determined (Transportation) OF-M2 – City Light Industrial Basin~~
- OF-17 – City Multiple Land Use Basin
- ~~St. Johns Bridge OF12A – ODOT – Oregon Department of Transportation (–ODOT)~~
- OF-49 – City Residential Basin
- ~~OF-22e OF-22C – Upstream~~ Upstream at Forest Park (Open Space Land Use)

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Also, phthalate analyses will take place at some ~~T-4~~ Terminal 4 locations to be determined in consultation with the Port. This results in a total of ~~112~~ locations known at this time that will receive phthalate analyses (Table 2-4a).

The target storm conditions for sampling are: storms predicted to produce ~~more than~~ >0.2 inches rainfall over a minimum of a ~~3-~~ hour period, not ~~to~~ exceed ~~approximately 2+~~ 2.25 inches in a 24 hour period (equivalent to the 2-year event), and ~~to~~ have been preceded by at least a ~~24-~~ hour dry period (~~less than~~ ≤ 0.1 inches rainfall). National Oceanic and Atmospheric Administration (NOAA) storm predictions will generally be used in the evaluation of storms potentially meeting these criteria (<http://www.wrh.noaa.gov/forecasts/graphical/sectors/pqrWeek.php#tabs>). ~~For each sampling location, drainage basins will be evaluated for basin size and runoff characteristics to facilitate calculation of expected discharge flows for a variety of storm conditions meeting the storm criteria. Samplers will be programmed to collect aliquots of stormwater following the discharge of the calculated “trigger volume” for each storm event.~~ The objective is to get a composite sample that represents aliquots collected into

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~~four~~seven 1.8-liter ~~one-gallon~~ bottles over the entire storm hydrograph (the eighth bottle in the sampler will be used for quality assurance/quality control [QA/QC]). This is the primary reason for the approximate maximum on the storm criteria above. However, this is only an approximate guideline that will be considered in the above evaluation of expected discharge flows and may be modified at one or more sampling locations. However, if storm flows exceed expected volumes, the sampling period will be ~~cut off~~concluded when the ~~four~~ sample bottles are full and thus in some cases, the falling limb of the storm hydrograph may not be sampled in its entirety.

Stormwater Grab Samples. ~~Stormwater~~During a ~~one-fourth~~ storm event, discrete ~~stormwater~~ “grab” samples will be collected from 10 locations where it is most likely that organics would be detected in water samples. Because the purpose of the grab samples is to collect partitioning rather than loading data, samples will be collected ~~samples and analyze the samples during storm periods expected to have higher COI concentrations (e.g., first flush or rising limb), to increase the likelihood of detecting low level COIs.~~ While all samples will be analyzed for ~~total and dissolved organic~~ TOC/DOC constituents. ~~The constituents, the~~ sampling locations were ~~reviewed~~selected based on general knowledge of site uses and potential sources. The following list (and in Table 2-4a) of locations, spanning the likely primary chemicals of concern for the harbor, was determined for this sampling:

- WR-24 – Oregon Steel Mills (PCB³s/phthalates)
- WR-121/123 – Schnitzer (PCBs/phthalates)
- WR-96 – Arkema (DDx/phthalates)
- WR-107 – Gasco (PAHs)
- WR-145 – Gunderson (PCBs/PAHs/phthalates)
- ~~St. Johns Bridge~~ OF-12a ~~Freemont Bridge~~ (PAHs)
- ~~OF-17 – Mixed Use (PCBs/PAHs)~~ ~~OF-12A – ODOT Fremont Bridge~~ (P (PAHs/phthalates) ~~(This will likely change to St. Johns Bridge)~~
- ~~OF-17 – Industrial/Residential/Open Space Land Use (PCBs/PAHs/phthalates)~~ ~~(Basin likely to change due to sampling infeasibility)~~
- ~~WR-22B – Front Ave. Props~~ OF-22B – Heavy Industrial (pPesticides, various)
- ~~WR-161 – Portland Shipyard (phthalates)~~ ~~WR-6 – Rhone Poulenc (Herbicides/Pesticides/PCBs)~~
- OF-22 – Willbridge (PAHs)

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³ All references to PCBs throughout this document refers to the analyses of PCB congeners (as opposed to PCB Aroclors).

Also, all composite samples for the Terminal 4 sites will include filtered and unfiltered pairs for all chemicals analyzed including organic compounds. ~~similar grab sampling may take place at some T-4 sites as determined in coordination with the Port. In addition, four of these sites are on the potential phthalates list for composite sampling, and thus, will be analyzed for phthalates. Other locations will not be analyzed for phthalates in grab samples.~~

The sample teams will collect the required quantity of water and transport it to the LWG Field Laboratory, where one aliquot will be filtered and distributed appropriately to bottles for laboratory analyses and a second aliquot will be distributed directly to bottles. ~~Each~~ Sample will be analyzed for the organic compounds shown in Table 2-22-4a and TSS. Additionally, organochlorine pesticides will be analyzed at Arkema, ~~Front Ave., OF-22B,~~ and Rhone-Poulenc (Table 2-4a-). Because filtering methods (e.g., filter matrix) differ between organic compounds and metals, metals will not be filtered and analyzed for these grab samples. Storm conditions for grab sampling are the same as for composite sampling described above, with grab samples taken sometime in the ~~emerging~~ rising limb of the hydrograph of a continuous storm meeting the above requirements.

Sediment Samples. Sediment traps will be installed ~~in within catch basins, junctions, or pipes at each sampling location~~ immediately upstream of the outfall discharge and downstream of the automatic sampler. -Figure 2-2 presents a photograph of a prototype of the sediment trap that will be deployed. The sediment trap will be placed adjacent to the outlet of the ~~stormwater~~ stormwater facility with the opening of the collection bottle at the same elevation as the invert of the outlet. Some sampling locations may require the use of sandbags or structural modifications to generate flow conditions conducive to sediment trap sampling. These sediment traps will be deployed at each location for a minimum target period of ~~three~~ 3 months. Sediment traps will be inspected at a minimum on a monthly basis. When inspected, if the collection bottle more than half full of sediments, the bottle will be collected and archived and an empty collection bottle will be returned to the trap. If the collection bottle is less than one third full at the first monthly inspection, options for repositioning or relocating the equipment or adding additional traps to obtain a better collection rate will be considered.

Sediments will be collected and archived throughout the 3-month deployment period. At the end of the deployment period, all sediments for each location will be combined and homogenized and sampled for analyses in the priority order shown in ~~until sufficient volume of sediment (as shown in Tables 2-2-3 and 2.4b as the available sediment volume allows.~~

~~) is available for the entire suite of analytes shown in Tables 2-2 and 2-3. If this occurs prior to completion of the 3-month deployment period, collection will continue for a second sample until the three-month duration is completed. In Tables 2-3 and 2-4b, analytes are ranked in priority order in the event that any collected sample size is insufficient to run all analyses. Given that some industrial sites are not known or~~

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suspected sources of organochlorine pesticides, but are potential sources for PAHs and phthalates, the priority order of these two chemical classes will be reversed for the following locations:

- WR-24 – Oregon Steel Mills
- WR-121/123 – Schnitzer
- WR-109 – Schnitzer Riverside
- WR-107 – Gasco
- WR-14 – Chevron
- WR-161 – Portland Shipyard
- ~~WR-1/5~~WR-4 – Sulzer Pump
- ~~WR-145 – Gunderson~~
- WR-148 – Gunderson (former Schnitzer)

Grain size is the last priority analyte. As discussed above, it is unlikely that large enough samples for grain size analysis will be obtained at most locations. ~~Thus, it is unlikely that more than one sediment sample will be obtained from each location.~~

Also, due to physical constraints, it may be impossible to deploy sediment traps at some locations. Contingency procedures in the event of this problem are discussed more in Section 4.3. One possible contingency measure is to pump and actively filter sediments from large volumes of stormwater at some sites. ~~Thus, this contingency back-up~~ technique is also described in Section 3.5.2.

Flow Measurements. ~~ISCO~~Isco Model 750 Area Velocity flow modules will be used in conjunction with the ~~ISCO~~Isco automatic samplers to allow the collection of flow-weighted composites at each sampling location. The flow modules will also continuously record flow data for the duration of sediment trap deployment. ~~This will allow accurate assessment of the total volume discharged. While~~As discussed in Section 1, flow meter precision or performance may not generate accurate discharge volumes for the entire monitoring period and will not be used to determine annualized loading estimates. ~~However, flow data from the period measured will be evaluated in conjunction with sediment trap results and with modeled discharge volumes modeled from the same period to understand potential variability and accuracy issues associated with estimating annualized loading from modeling methods, during the period of sediment trap deployment.~~

All sampling equipment will be deployed at locations that are as close to the point of discharge (for outfall locations) or the last junction⁴ associated with the land area of interest (for the land use based locations). In all cases, equipment will be placed at elevations sufficient to minimize the potential for river water to back up to the sample location and compromise [flow data quality](#), the [integrity of the sediment traps and](#) collection of true stormwater samples.

2.4 SAMPLE ANALYSIS

Stormwater and sediment samples will be analyzed as described below. Table 2-~~45~~ summarizes the analytes and methods of analysis for each analyte group for each sample type (sediment and stormwater).

2.4.1 Water Samples

The stormwater samples will be analyzed for pH, conductivity, turbidity, ~~dissolved oxygen~~, and temperature in the field. Stormwater samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized on Table 2-~~45b~~. It is anticipated that sufficient sample volume (as noted in Table 2-3) will be collected during each stormwater event to conduct all analyses listed in Table 2-~~45b~~. The specific analytes for each parameter group and the analyte concentration goals (ACGs) are included on Table 2-~~56b~~. Table ~~2-42-2~~ shows the number of natural samples and identifies the QA/QC samples for each sampling event. A [Quality Assurance Project Plan \(QAPP\)](#) Addendum for the Round 2A QAPP (Integral and Windward 2004) for this investigation is presented ~~under separate cover in Appendix H~~. The QAPP Addendum summarizes the analytical program and provides details on the laboratory methods, QA procedures, and QA/QC requirements.

2.4.2 Sediment Samples

The sediment samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized on Table 2-~~45a~~. The analytes are listed in the priority for analysis in Table 2-3. If sufficient mass (as shown on Table 2-3) is not available to complete all analyses, the analyses will be conducted by the laboratory in the priority order identified in this table. Any additional mass available, will be used for laboratory quality control analyses (matrix spike samples, laboratory duplicate samples, matrix spike duplicate samples). The specific analytes for each parameter group and the ~~analyte concentration goals (ACGs)~~ are included on Table 2-~~56a~~. Table 2-2 shows the number of natural samples and identifies the QA/QC samples for each sampling event. A QAPP Addendum for the Round 2A QAPP (Integral and

⁴ The term "junction" refers to any accessible location where two or more pipes are joined by a structure such as a manhole. This may include locations where drainage from surface runoff also enters the junction, such as catch basins that connect two or more pipes.



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Windward 2004) for this investigation is presented under separate cover in Appendix H. The QAPP Addendum summarizes the analytical program and provides details on the laboratory methods, QA procedures, and QA/QC requirements.

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3.0 SAMPLE COLLECTION AND PROCESSING PROCEDURES

The following sections describe the ~~detailed~~ sampling procedures, record keeping, sample handling, storage, and field quality control procedures that will be used during stormwater and sediment sampling.

3.1 FIELD LOGBOOK AND FORMS

All field activities and observations will be noted in a field logbook during fieldwork. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general [sample and runoff](#) observations. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the FSP) and the reasons for these changes will be documented in the field logbook. Logbook entries will be clearly written with enough detail so that participants can reconstruct events later, if necessary.

A sample collection checklist will be completed following sampling operations at each station. The checklist will include station designations, types of samples to be collected, and whether field replicates/duplicates, rinsate blanks, or additional sample volumes for laboratory QC analyses are to be collected. A set of field log forms is included in Appendix E

3.2 EQUIPMENT AND SUPPLIES

Equipment and supplies will include sampling equipment, utensils, decontamination supplies, sample containers, coolers, logbooks and forms, personal protection equipment, and personal gear. Protective wear (e.g., gloves, [steel-toed boots](#)) will be worn by field personnel as specified in the [Health and Safety Plan \(HSP\)](#) (~~Appendix H~~; [Integral 2004b](#)).

A detailed list of sampling equipment and supplies are listed in SOP Appendices as follows:

- Stormwater composite sampling – Appendix A
- Stormwater grab sampling – Appendix B
- Sediment sampling – Appendix C
- Flow meter measurements – Appendix D

The analytical laboratory will supply sample containers and preservatives, as well as coolers and packing material. Commercially available pre-cleaned jars will be used, and the laboratory will maintain a record of certification from the suppliers. The bottle shipment documentation will record batch numbers for the bottles. With this

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documentation, bottles can be traced to the supplier, and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the project file. Field personnel will not obstruct these stickers with sample labels.

Sample containers will be clearly labeled at the time of sampling. Labels will include the project name, sample location and number, sampler's initials, analysis to be performed, date, and time. The nomenclature used for designating field samples is described in Section 3.6.

3.3 EQUIPMENT DECONTAMINATION PROCEDURES

The following is a brief description of decontamination procedures for each set of equipment. Details of these procedures are described in Appendices A, B, and C.

3.3.1 Water Sampling Equipment

Any portion of the tubing, pump, filters, and ~~ISCO~~Isco sampler or other materials coming into contact with sampled stormwater will be decontaminated prior to use or certified pre-cleaned from the equipment source. Appendices A and B contained detailed procedures and equipment material requirements to avoid potential contamination of samples. These procedures are summarized below.

The top cover, center section, retaining ring, and tub of the automatic sampler will be cleaned with warm soapy water and rinsed with tap water. The two pump drain holes will be checked to see that they are open and free of debris or buildup.

The sampler intake tubes and screens will be cleaned and stored until they are deployed using the decontamination procedure in Appendices A and B. During implementation of the FSP, it is not anticipated that screens and intakes tubes will be removed for cleaning between sampling events. The sampler will be programmed to purge the intake tubes several times before and after each stormwater sample is collected, which should ensure that any contamination from previous events is removed or sufficiently diluted to be unimportant. If upon routine inspection, it is observed that algae is growing in the intake tube, debris is blocking the tube, or any other gross contamination issues may exist, it will be replaced with a tube and screen decontaminated per Appendices A and B.

The Teledyne/Isco glass sample bottles will be sent to the analytical lab for cleaning and returned to the LWG Field Laboratory for deployment. The procedure for these bottles is described in Appendices A and B.

Mounting equipment such as slip rings, nuts and bolts, brackets will be washed with warm soap water using a brush to remove any oil, grease, or other residue from the manufacturing process. They will then be rinsed with spectro-grade acetone and then with tap water and allowed to dry. A warm oven could be used to speed drying.

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When installing the brackets in the field at the sampling sites, it may be necessary to drill holes or use powder actuated tools to set studs, weld, or use other means to attach the sampling hardware that may create some debris that could become a contaminant source. After the studs are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with ~~D~~deionized water before the sampling hardware (intake screen) is mounted.

3.3.2 Sediment Sampling Equipment

Sediment Traps. Any portion of the sediment trap bottle, sample collection, and homogenization equipment coming into contact with sediment samples will be decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed ~~decontamination~~decontamination procedures for sampling equipment are included in the Appendix C. The following paragraphs summarize the cleaning procedures.

The sediment traps consist of a stainless steel bracket and a glass bottle. The mounting bracket, nuts and bolts, brackets will be washed with warm soap water using a brush to remove any oil, grease or other residue from the manufacturing process. They will then be rinsed with spectro-grade acetone and then with tap water and allowed to dry. A warm oven could be used to speed drying.

The glass sample bottles will be sent to the analytical lab for cleaning and returned to the LWG Field Laboratory for deployment or purchased and delivered as "Certified Clean." The decontamination procedure for the bottles is described in Appendix C.

When installing the brackets in the field at the sampling sites, it may be necessary to drill holes or use powder actuated tools to set studs, weld, or use other means to attach the sampling hardware that may create some debris that could become a contaminant source. After the studs are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with ~~D~~deionized water before the sampling hardware (sample bottle holder) is mounted.

Water Filtering for Sediment Collection (Back up Procedure). Any portion of the tubing, pump, filters, or other materials coming into contact with sampled stormwater will be decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed ~~decontamination~~decontamination procedures for sampling equipment are included in Appendix C.

3.4 STORMWATER SAMPLE COLLECTION PROCEDURES

Stormwater collection procedures are described in detail in Appendices A and B. Two methods of stormwater collection will be used:

- Flow weighted composite sampling of organics, metals, and conventionals that will be collected using an automated ~~ISCO~~Isco

pump and sample container system and Teflon™ tubing (Appendix A).

- Grab water sampling of organics and conventionals using ISCO pump, sample containers, and Teflon tubing (Appendix B).

The appendix SOPs for stormwater sampling follow the general concepts used in the sampling and analysis of trace metals in relatively clean surface waters. Examples, of these procedures are the guidelines in EPA's Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996), and by the *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001). These methods use the "clean hand-dirty hand" (or CH/DH) approach to sample collection. Because this sampling effort does not involve sampling trace levels of chemicals in relatively clean surface waters there is no need for a strict CH/DH procedure. However, the general concept of separating equipment and sample handling jobs to minimize the potential for contamination of samples is employed throughout the SOPs. Detailed procedures for each type of sample collection that follow this general concept are described in Appendices A and B.

3.4.1 Summary of Composite Stormwater Sampling Methods

Stormwater samples for standard chemical and conventional analyses will be collected using a peristaltic pump through a Teflon-lined intake tube with a Teflon coated stainless steel pickup screen. The tube and screen will be attached to the bottom of the junction outlet along with the Area Velocity (AV) flow sensor (described more below), with an extended sampling tube fixed at the desired location in the catch basin outlet. The pre-cleaned ISCO sampler (following procedures discussed above) will be delivered to the sample site by the sampling team.

Wherever possible, the sampler will be located above ground and next to the catch basin or the junction selected for sampling. The pick up screen and the AV flow sensor will be installed on the sensor carrier that is was installed when the sediment traps are were installed. Although there are tools that allow surface installation of sensors, confined space entry may be required to install the pickup screen and flow sensor. If confined space entry is required, it shall be done in accordance with the procedures in the HSP (Appendix H). In addition, at some locations accessible to the public (e.g., manholes on streets), the actual sampler will be installed within the junction or catch basin selected for sampling. If confined space entry is required for any location, it will follow procedures in the HSP Addendum (Appendix H). This procedure will also have to follow Appendix H.

After the pickup and sensor have been installed, the sampler will be powered up and allowed to go through the self check process. If the sampler checks is acceptable, the

sample bottles will be installed ~~using the CH-DH procedure~~. Once the bottle section of the sampler is closed, the sampler will be enabled. The sampler will then be lowered into the ~~junction catch basin~~, if necessary, or otherwise secured above ground on the site. Care will be taken not to pinch or kink the pick up tube of the flow sensor cable.

Once the sampler is deployed and the cover is closed, the sampling team leader, or designate, will call the sampler to disable it until an appropriate storm is forecasted. The automatic sampler, when enabled, will be programmed to initiate sampling once ~~a~~ specified trigger conditions (e.g., flow depth and/or volume) have flow rate has been exceeded been met and will continue to sample until the flow rate decreases below the trigger level conditions are no longer met within the 24-hour sampling duration or the bottle capacity is reached. The trigger flow rate will likely conditions will be different for each sampling station due to differences in basin sizes, pipe/junction configurations, and runoff characteristics, vary as well as -and there may be non-stormwater discharges such as base flow.

The sampler will collect flow weighted samples into ~~4seven one-gallon~~ 1.8-liter glass bottles. The sampler will be programmed to collect flow proportional sample volumes. Samples will collected on a uniform time basis and the volume collected at each time step will be proportional to the volume of water that has passed the flow meter since the previous time step. The sampler collects the stormwater in 10-ml increments. The number of 10-ml increments collected at each time step is dependent on the flow rate and the sampler programming that is unique to each sampling site. The volume of stormwater water that passes the flow module per 10-ml sample increment will be estimated for each basin to maximize the likelihood that the minimum volume of water required for analysis is collected without exceeding the total bottle volume capacity of the sampler.

The samplers will be programmed with several sample routines that will vary the sample size based on the anticipated rainfall. The minimum volume collected will be based on the minimum storm expected to generate runoff (0.2 inches). The maximum volume will be based on the forecasted precipitation with some allowance for under-predictions of rainfall associated with a storm.

It is possible during a given event that not all the sample bottles are filled or that the bottle volume is exceeded due to differences between the forecasted precipitation and the actual precipitation at the site. The flow data collected at the time of sample collection will be examined to determine if the sample appears to be valid or needs special compositing considerations (as described below) before compositing and shipment to the analytical lab.

After the sampling event, the sampling team leader will call the sampler and disable it if the storm event concludes prior to the 24-hour cutoff, to prevent additional stormwater from being collected if the flows increase. The sampling team will retrieve the automatic sampler and ~~using CH/DH procedures~~ remove sample bottles and seal them with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field

Laboratory. The sampling team will install new bottles and re-deploy the sampler as described previously. The Isco samplers will be decontaminated prior to the first installation and will not be subsequently decontaminated except as noted above and in Appendix A.

At the LWG Field Laboratory, the sampling team will ~~be~~ combine the samples into a single composite and samples will be filtered (for metals analyses only) and/or otherwise prepared for laboratory analyses. The compositing, ~~and~~ filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. Field filtering procedures for metals are described in detail in Appendix A. Throughout this process, the samples will~~shall~~ be handled following the procedures described in the Chain of Custody SOP (Appendix F).

As part of the field sampling procedures, the sampling team will download the sampling report and flow data from the data logger. The field collected samples will be transported to the LWG Field Laboratory and left in their respective coolers, or refrigerated, until the sampling report and flow data can be reviewed. If the sampling report and flow data indicate that there was no malfunction and all the sample bottles are intact, the compositing and sample preparation would continue as described in Appendix A. The samples would be emptied into a large sample container and mixed (i.e. using a churn splitter or other suitable apparatus) while samples are distributed to sample bottles for laboratory analyses.

Several problems could occur that may affect the viability of a sample collected. Common potential problems and contingencies are as follows.

1. Sample volume is not adequate to do all of desired analyses. This may occur when the forecasted precipitation is substantially greater than the actual site precipitation. Under these sampling conditions, the sample will be composited as normal and samples for analyses will be prepared in the priority shown in Table 2-3.
2. Sample exceeds bottle capacity. The sampler report indicates that the bottle capacity was exceeded. This may occur when the forecasted precipitation is substantially less than the actual site precipitation. In this case the flow data will be evaluated; if the collected samples represent 50 percent% or greater of the total storm and encompasses some of the falling limb of the storm, the total volume will be composited and analyzed per normal procedure. If the sample volume represents less than 50 %percent of the total storm volume, it should be composited and held at the LWG Field Laboratory under conditions shown in Table 3-2 for possible later analyses in the event that no further storm events can be successfully captured.
- 4.3. A portion of the sample is lost. This would occur when one or more of the sampling bottles was damaged or the sampler malfunctioned. In this situation, the

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sampling report and flow data will be reviewed to determine what representative portion of the storm volume is missing. In this situation, it may be possible that a significant portion of the storm was not sampled, and/or there is not adequate volume to complete the desired analyses. Following the process of the two previous scenarios, if the sample includes sample that represents 50 percent% of the storm and both rising and falling limb conditions are included, then the sample will be used. If not, it will be archived at the Field Laboratory as described above. If the sample meets the above conditions but the volume is inadequate to conduct all analyses, the sample containers will be filled in the priority order of analyses shown in Table 2-3.

3.4.2 Summary of Grab Stormwater Sampling Methods

Stormwater grab samples for standard chemical and conventional analyses will be collected using a peristaltic pump that is part of the ~~ISCO~~ Isco automatic sampler. The ~~ISCO~~ Isco sampler will be removed from the ~~catch basin sampling location~~ by the sampling team. ~~Using the CH/DH procedure~~ The sampler case will be opened and the delivery tube will be removed from the bulk head fitting. A Teflon lined tube will be connected to the bulkhead fitting to collect the desired samples. The sampler will be put into "Grab" mode and the specified volume will be programmed into the sampler. Once activated, the sampler will purge and the grab sample will be collected ~~into four one-~~ gallon jars.

The sampling team will seal, ~~using CH/DH procedures~~, the samples with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field Laboratory. The sampling team will remove, ~~using CH/DH procedures~~, the grab sampling tube from the bulkhead fitting and reconnect the distribution tube and close up the sampler. The sampling team will re-deploy the sampler as described previously.

At the LWG Field Laboratory, the sampling team will combine the samples into a single composite for each event and samples will be filtered ~~and otherwise pre prepared~~ for laboratory analyses. The compositing, ~~and~~ filtering, ~~and sample preservation~~ will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. Field filtering procedures for organic compounds are described in detail in Appendix B. The samples shall be handled following the procedures described in the Chain of Custody SOP (Appendix F).

3.4.3 Flow and Rain Data Collection

Flow will be measured with the Teledyne/Isco 750 AV Module (module). The module is an add-on enhancement to the Teledyne/Isco's 6700 Series Samplers that are being used to collect stormwater samples. The module provides the ability to collect flow proportional sample volumes and flow-paced samples. The sampler displays the real-

time level, velocity, flow rate, and total flow provided by the module. The sampler records this data for later analysis.

The module is designed to measure flow in open channels without a primary device. (A primary device is a hydraulic structure, such as a weir or a flume, which modifies a channel so there is a known relationship between the liquid level and the flow rate.) Area velocity flow conversion requires three measurements: water level, velocity, and pipe dimensions. The AV sensor provides the level and velocity measurements. The pipe dimensions will be measured in the field and entered during module programming. The flow calculation is made in two steps. First, the module calculates the pipe cross-section (or area) using the programmed pipe dimensions and the level measurement. Then, the module multiplies the channel cross section and the velocity measurement to calculate the flow rate.

The sampler will be programmed to use the customary U.S. measurement units, such as feet (depth), cubic feet per second or gallons per minute (flow, depending on size of the contributing basin), and gallons or millions of gallons (volume, depending on the size of the contributing basin). The sampler will be programmed to record flow data at 5-minute intervals. These data will be periodically downloaded throughout the course of the sampler deployment (as determined by data storage capacity) and entered into the project database.

In addition, data on rainfall will be obtained from various existing established rain gauge stations around the Portland area. These data will be used to make sampling decisions throughout the course of the sampling and to understand flow results for data reporting.

3.5 SEDIMENT SAMPLE COLLECTION PROCEDURES

Collection procedures for stormwater sediments are detailed in Appendix C and summarized below.

3.5.1 Sediment Traps

As described in Section 2.3, sediment traps will be deployed at each location for a minimum target period of three months. Sediment traps will be inspected on a monthly basis at a minimum ~~on a monthly basis~~. When inspected, if the collection bottle is half full, sediments will be collected and archived and a clean bottle, filled with Deionized water (to prevent floating) will be returned to the trap. This process will be repeated, and sampled sediments archived at the LWG Field Laboratory for additional later compositing until sufficient volume of sample is obtained for all analytes or the trap deployment period ends. ~~If sufficient volume was obtained prior to~~

~~the end of the deployment period, the procedure below will be followed at that time and the trap container redeployed. Sample obtained from the remainder of the deployment~~

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~~period will be handled per the procedures below, except in that case the step regarding compositing with the archives would be skipped.~~

Sediment samples will be capped with Teflon lined lids, labeled, sealed and packaged appropriately for transport to the LWG Field Laboratory. At the field laboratory, the samples will be removed from the sampler bottles and stored in wide-mouth jars in the freezer~~stored in the refrigerator.~~

~~Once sufficient sample volume has been obtained or the deployment period has ended, all sampled sediments (including archived aliquots) will be combined in one decontaminated stainless steel bowl using decontaminated stainless steel implements and thoroughly homogenized and subsampled in sample containers for chemical analyses.~~

~~To remove~~ Sediment removal from the sample bottles will require several steps as the bottle opening is approximately 1/2 inch in diameter. The sampling technician will decant most of the water from each sample bottle into a decontaminated flask. The technician will then swirl or stir, ~~with a decontaminated stainless steel implement,~~ the remaining water with a decontaminated stainless steel implement to mobilize the sediments. The technician will then pour the slurry into a decontaminated funnel with ~~2-5 micron filter paper~~appropriate filter material and allow the leachate to drain to a decontaminated flask. Once the sediment has drained ~~to the appropriate~~ to a consistency allowing homogenization with a stainless steel spoon, the sample can be lifted out by the filter material and ~~placed~~dumped into the decontaminated mixing bowl~~storage jar~~. The leachate water and the decanted water then can be used to rinse the sample bottle and remove the last of the sediments. Once all the sample bottles have been emptied and the sediments have been added to the mixing bowl~~storage jar~~, a stainless steel spoon can be used to scrape off any sediments that have adhered to the filter material into the mixing bowl~~storage jar~~. The leachate water or decanted water can be used to rinse the filter material or add moisture if needed, ~~to homogenize the sediments~~

Once the deployment period has ended, all sampled sediments (including archived aliquots) will be combined in one decontaminated stainless steel bowl using decontaminated stainless steel implements and thoroughly homogenized and subsampled in sample containers for chemical analyses.

Sample analysis containers will be filled in the priority order shown in Table 2-3, except for the alternate priority for some locations as described in Section 2.3, until the bowl is empty.

3.5.2 Water Filtering for Sediment Collection (Back up Procedure)

This procedure will be used in the event that a sediment trap cannot be deployed at a location because of limited space availability or other logistical reasons. To mimic the deployment of sediment traps, this procedure ~~would~~ be employed over several storm events at the location in question. The ~~sediment samples obtained results over several events will then be composited in the analytical laboratory could then be "composited" on~~

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~~paper to mimic the deployment of a sediment trap over 3 months. This would require greater number of sample analyses than currently budgeted for sediment trap analyses.~~

Large volumes of water will be pumped through Teflon™ tubing to collect the particulate fraction from the water for subsequent analysis of the particulate fraction. Currently, two techniques are being evaluated as options for sediment collection: collection with a portable continuous flow centrifuge pump; and collection with a peristaltic pump system with sequential filters and glass fiber filter cartridges. The total volume of water pumped for each sample will be determined based on the analytes selected for the station. Table 3-1 provides estimates of stormwater sample volumes required for each of these sample collection techniques

The portable continuous flow centrifuge pump system samples would be collected by pumping water from the sample location (~~catchbasin or~~ junction) and sequestering the suspended particles in sample collection jar, which would avoid collecting and retaining large volumes of water for subsequent filtration. The accumulated sediment would then be transferred from the centrifuge pump sample collection vessel, homogenized, and subsampled into sample jars for chemical analysis. The peristaltic pump system would require a high pressure tubing setup and large volume capacity filters, in series, to extract the suspended particles. The large capacity filters would be connected in series with the smallest pore size of 4 or 5 µm, which is the low-end range for silt particles (ASTM 1985). The peristaltic system could be conducted by collection of water into a container (e.g., 20L carboy) and subsequent filtration. The reconnaissance survey will help determine whether the high-volume collection could be conducted directly from the outfall sampling location without intermediate storage. The minimum filter pore size to be used will be 4-5 µm.

Samples will be collected using the using methods that minimize the potential for contamination through sample or sample equipment handling and will follow the general concept of the CH-DH approach described above.~~“clean hand—dirty hand” method.~~ Once the desired volume is pumped, the glass fiber filters will be removed, placed in sample jars, and stored in a cooler containing wet ice. At the analytical laboratory, the filters will be archived until the last sampling event is conducted. Once filters from the last event arrive in the laboratory, the laboratory technicians will combine the sediments from all the filters at each location and homogenize using clean implements. The resulting homogenized sediment sample will be analyzed to determine the concentration of chemicals present within the collected particulates. Detailed procedures for this sampling technique are described in Appendix C.

3.6 SAMPLE IDENTIFICATION

All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and

LWG data management, validation chemists, and data users. The ~~A~~-unique code will be assigned to each sample as part of the data record. ~~This code~~ and will indicate the project phase, sampling location, sample type, sampling event, and level of replication/duplication. ~~All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and LWG data management, validation chemists, and data users.~~ Sample identifiers will consist of two to three components separated by dashes. The first component, LW23, identifies the data as belonging to the Lower Willamette River RI/FS as a part of the Round 3 sampling. The second component will begin with the abbreviation "STW" to designate the stormwater sample, followed by a CW, GW, or S for composite water, grab water, or sediment, followed by a single-number code that designates the sampling event. The station number will complete the second component.

Additional codes may be adopted, if necessary, to reflect sampling equipment requirements. Leading zeros will be used for stations with numbers below 100 for ease of data management and correct sorting. The third component will be used to code field duplicate and replicate samples ~~and splits~~. A single digit number will be used to indicate field duplicates or splits in the third component of the sample identifiers. For equipment decontamination blanks, sequential numbers starting at 900 will be assigned instead of station numbers. The sample type code will correspond to the sample type for which the decontamination blank was collected.

Example sample identifiers are:

- LW2-STW-CW-1022: stormwater composite sample from Station 22 collected during the first sampling event.
- LW2-SW-CW-1022-1: stormwater composite sample from Station 22 collected during the first sampling event; field duplicate ~~is or splits are~~ associated with this sample.
- LW2-SW-CW-1022-2: field duplicate or split stormwater stormwater composite sample from Station 22 collected during first sampling event.

3.7 SAMPLE HANDLING AND STORAGE

The number, size, and type of sample containers needed for each sample are listed in Table 3-2. This table also includes the preservative and holding times for the various analyses. In general, preservatives will be added to the sample containers by the analytical laboratory prior to shipment to the field. The sampling team will confirm the presence or absence of preservative in the containers prior to filling. Any discrepancies with preservatives will be noted on the field sampling records, and corrective action will be initiated.

Once the sample is collected and preserved ~~using the CH/DH technique~~, the sample container will be capped, labeled, and placed in double-sealed polyethylene bags and stored on ice or refrigerated until shipped to the laboratory under the chain-of-custody procedures outlined in Appendix F

Each storage freezer or refrigeration unit in the LWG Field Laboratory will be monitored ~~bi-weekly~~ daily to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

3.8 QA/QC

Field QC samples are used to assess sample method variability (e.g., replicates); and sample variability (e.g., duplicates); evaluate potential sources of contamination (e.g., equipment rinsate and ~~decontaminate~~, and trip blanks), or confirm proper storage conditions (e.g., temperature blanks). The estimated numbers of field and QC samples are listed in Table 2-2. Details on field replicate samples and field QC samples are described in the QAPP Addendum ~~in Appendix H~~.

In summary, the QAPP Addendum describes ~~quality assurance/quality control (QA/QC)~~ procedures that will be used to complete the storm-water investigation. The QAPP Addendum for the storm-water investigation was developed within the framework of the existing LWG Round 2 QAPP (Integral and Windward 2004) and Addenda (Integral 2004a) for the ~~on-going~~ ongoing LWG investigations.

For sediment trap samples, the mass of material collected is anticipated to be limited. For sediment samples, the QAPP Addendum includes the collection of field QC samples and additional mass for laboratory QC samples (matrix spike, matrix spike duplicate or laboratory duplicate) as follows and per Table 2-2:

- Field replicate, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for phthalates, 1 per 20 samples

Field replicates will be generated by deploying sediment traps with additional sample collection vessels, and compositing the sediment from each half of the sediment trap collection vessels, separately, into two subsamples for analysis. Deployment of two vessels will only be possible at some of the locations, due to expected space limitations within the junctions. Consequently, after the location reconnaissance, the locations of the replicate trap deployment will be determined based on available space and other constraints noted above for sediment trap deployment. Replicate trap deployment will be conducted at sufficient locations to meet the 1 in 20 requirement. If this is not possible, the replicate analysis will be substituted with a duplicate analysis consisting of homogenizing sediment from one vessel and splitting into two equal aliquots for

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analyses, at locations where sufficient volume is present, so that the 1 in 20 requirement.
Analysis for laboratory QC samples will be conducted by dividing the total sediment collected from one sediment trap vessel at select locations with sufficient volume into three aliquots of equal mass for the laboratory analysis of the sample, matrix spike, and matrix spike duplicate.

For water samples, the sampling program will be designed to collect additional volume for field and laboratory QC samples. The QC program for water samples includes:

- Field ~~replicates, duplicates,~~ 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for all analyte groups, 1 per 20 samples.

The inclusion of phthalates in the analyte list requires careful consideration in the design of the sample collection program to ensure that the sediment and water samples do not come into contact with phthalate-containing material. Because the water samples require pumping and additional handling for compositing, the likelihood of field contamination from contact with phthalate-containing components increases and could result in qualification of the data if phthalates are detected in the associated field blank samples. The procedures detailed in Appendices A, B, and C include careful consideration of the materials and handling procedures used in order to avoid such sampling contamination if at all possible.

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It is likely that the samplers may be deployed with open bottles for several weeks before a storm sample is collected. Air-borne deposition of chemicals from the sampler bodies, which are made from various plastic materials, or ambient atmospheric urban sources may be potential source of contamination to the open bottles. Consequently, the bottle eventually used for the rinsate blanks will also be left un-capped inside the samplers during sampler deployment and will be handled identically to the actual samples during the sample collection process.

4.0 SAMPLING IMPLEMENTATION AND SCHEDULE

4.1 SAMPLING TEAMS AND ORGANIZATION

In order to implement the stormwater sampling program, a team approach has been developed to prepare the FSP, install and maintain sampling equipment, collect samples and deliver them to the laboratory, and finally report the data. As shown on the organization chart (Figure 4-1) Anchor has the lead role in implementing the FSP. The following discussion briefly outlines the duties of the key participants.

Mr. Stivers will act as the overall Anchor project manager. As the manager, he will act as the key contact to the Portland Harbor technical and management teams. In addition, Mr. Stivers played a key role in the development of the monitoring strategies, selection of monitoring sites, identifying the constituents to be monitored, and ensuring the FSP meets the overall study objectives noted in Section 1.

Mr. Page is overseeing the field program and is the lead author of the FSP. He will participate in the station reconnaissance and preparation, described in the following section. He will direct the sampling teams when to activate the automatic samplers, equipment installation, assist in troubleshooting equipment problems, and be available to act as an alternate on the sampling teams.

The sampling teams will be lead by an Anchor water quality specialist familiar with the equipment operation. Each team will also have a specialist from Integral to oversee the collection, processing, and shipment of the samples to the laboratory. The team leader will have the responsibility to deploy and redeploy their automatic samplers as needed, activate their automatic samplers when notified of a storm meeting the sampling criteria is imminent, conduct collection the samples in a timely manner, [download sampler storm event data](#), conduct or coordinate delivery of the samples to the LWG Field Laboratory, coordinate delivery of samples to the analytical laboratories, filling out all field forms and chain of custody forms, and ensure that all field work is conducted in accordance to the HSP ([Appendix H-Integral 2004b](#)).

The [O&M operations and maintenance](#) team will be based in Portland and have responsibility to routinely inspect and repair the sediment traps, ~~ISCO~~ samplers, and other equipment, [calibrate flow meters and samplers as needed](#), download the [flow](#) data loggers, and rotate the batteries in the automatic samplers to ensure that they are ready at all times to initiate sampling. They may also deliver samples to the LWG Field Laboratory as ~~needed~~.

[needed](#).

The Field Laboratory Team will assist in the processing, tracking, and archiving of samples, maintain sample archives, conduct packing of coolers and filling out chain-of-custody forms for laboratory delivery, will coordinate with the laboratories for sample

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delivery and/or pickup, facilitate the tracking of samples, and coordinate with laboratories to ensure correct analyses following the QAPP addendum are conducted.

The laboratories used for the sampling program are listed in Table 2-45. The laboratories will be responsible for providing “certified clean” sample bottles and equipment to the sampling teams, coolers and packaging materials, labels, seals, and chain-of-custody forms. The laboratories will designate a project coordinator ~~that who~~ will be responsible for receiving the samples from the field laboratory team and coordination of data reporting. The laboratory coordinator will also be responsible to ensure that the samples are analyzed according to the specified methodologies.

4.2 STATION RECONNAISSANCE AND PREPARATION

Sample locations will be verified during a reconnaissance visit consisting of the sampling team leader for those sample locations and persons knowledgeable with the particular location in question. Conditions encountered in the field during implementation of this ~~FSP plan~~ may result in modifications to the sampling design at some or all locations. The Stormwater Technical Team will be made aware of the conditions and will approve ~~substantial~~ the location-specific modifications ~~to the FSP of the plan~~.

During the reconnaissance survey, the teams will identify the targeted discharge point and inspect the site to identify the location where the equipment can be installed to meet the sampling objectives. At each site, the team will locate the junction or structure catch basin or structure access location nearest the outfall where the equipment may be installed. At these locations, the team will:

- a Attempt to determine ~~whether the river back up is likely (determine the sampling locations)~~ site elevation ~~from the site map as well as measuring down to the invert of the junction structure outlet and comparing known or measured relative elevations to observed elevations of shoreline features such as the limit of permanent vegetation (which is often approximately equivalent to ordinary high water mark within the Portland Harbor area)~~ invert elevation to MHHW ~~Ordinary high water (OHW) or specified elevation (Figure~~
- V ~~erify~~ that flow conditions are conducive to flow-paced sampling ~~(e.g., orientation of incoming laterals, debris);~~
- V ~~erify~~ that there is space available within or adjacent to the site ~~for to secure the ISCO~~ automatic sampler;
- V ~~erify~~ that there is space available to install the sediment trap ~~and/or replicate traps for some locations; and~~
- M ~~ea~~sure outlet pipe size to order or fabricate the appropriate mounting brackets for the sampler pick up tube, flow meter sensor, and the sediment trap.

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The primary purpose of determining the sampling location elevation will be to determine whether back up of river water into the junction or adjoining pipes is reasonably likely. Such a condition will be avoided to prevent sampling of river water instead of, or in combination with, stormwater. Table 4-1 presents statistics on river heights based on USGS data from the Morrison Street Bridge gauge for the proposed months of sampling. This gauge is located 2.9 feet above City of Portland datum (i.e., add a value of 2.9 to the Morrison Street Bridge gauge height to obtain a value in City of Portland datum). As shown in Table 4-2, the upper range (i.e., above 80th percentile) statistics on the average monthly river height in this period is in the range of 10 to 14 feet as measured by the gauge. Because a monthly average does not explicitly capture daily highs that may have occurred within any given period, the daily 90th percentile statistics are also presented. The upper range (i.e., above 80th percentile) statistics on these values range from 11.9 to 17 feet in this period, as measured by the gauge.

No specific criteria for acceptable junction elevation are proposed here. Rather, the field reconnaissance information for each location (and potential alternate locations) should be compared to Table 4-2 to determine the relative likelihood of river back upriver backup at any particular location. The field crews will make determinations in coordination with the Stormwater Technical Team of acceptable levels of risk for river backup at each sampling location. These decisions will also consider other factors such as the relative feasibility of moving to a nearby location (i.e., within the same basin) and the availability of any other alternate locations (i.e., in other basins entirely) that might also meet the objectives of the location in question. For example, where few if any nearby or alternative sampling locations exist that meet the intended objectives of the sampling location, then acceptance of a greater risk of river back upriver backup at a particular location may be warranted. Conversely, if an alternate location that meets all the location objectives can easily be found, there should be a relatively low tolerance for the potential of river back upriver backup at a given location.

Where the junction elevation of a particular location appears to have a reasonable potential for river back upriver backup based on the field reconnaissance information, additional more accurate surveys of the location elevation may be warranted and will be conducted as necessary to reach decisions consistent with the above framework.

Another key measurement that will be needed is the depth of the junction structure below the invert of the outlet. Ideally, The sediment traps will need to be mounted adjacent to the outlet with the opening of the sampling bottle at the same elevation of the invert. If the bottle is located higher, it may not effectively collect the heavier fractions of the sediment or may introduce excessive turbulence that interferes with the function of the flow meter. In some situations, this ideal location may not be possible and alternate locations within the junction structure that would be expected to still capture substantial amounts of sediments and avoid excessive turbulence may need to be evaluated and determined.

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In addition, the team will attempt to identify any non-stormwater flows that could enter the conveyance during the sampling period (e.g., groundwater, stream flows, sheet flow from adjacent sites, batch discharges). Depending on the source, the location-specific procedures may sample plan may need to include collection of information on the nature, amount, and timing of those flows.

If space is not adequate to install the equipment, the targeted sampling location is not adequate, the team will move upstream to the next available representative structure for evaluation. Anchor will report the identified sampling locations to the Stormwater Technical Team for approval. It is possible that a suitable monitoring station cannot be found and an alternative outfall will be needed to be selected to meet the study goals, see Section 4.3 for a discussion of the contingency process for selecting and alternative sampling location

4.3 BACKUP AND CONTINGENCY PROCESS FOR LOCATION SELECTION AND SAMPLING

If it is determined that a sediment trap or automated water sampler deployment is infeasible for the selected basin outfall location, basin, or that available sampling locations within that basin will not meet location objectives (i.e., are not representative of targeted land uses or sites activities), several alternatives may be implemented.

4.3.1 Land Use Based Sampling Sites

If it is a land use based sampling site, another representative outfall or basin could be selected; alternately, another location within the basin could be selected, as long as the remaining basin area is still representative of that land use. Based on the identification of a physically suitable site by the reconnaissance team, as described previously, the site will be re-evaluated in the office. The selected location will be first compared to the infrastructure maps to determine what areas will be captured by the sampling location. The land uses in the captured area will be evaluated to determine if they meet the sampling goal.

If the revised basin does not meet the land use selection criteria an alternative outfall will be selected and a reconnaissance survey will be conducted to determine if the equipment can be installed.

Time is of the essence to collect the stormwater samples in the 2006/2007 rainy season. From that perspective, selecting a truncated area of the original basin would be superior if the remaining area provided the land use characteristics desired. Deciding to look for an alternative basin and investigating it may result in not getting the desired number of water quality samples or the desired volume of sediment. However, because all the equipment will not be delivered and installed simultaneously, there may be a two-week period during which an alternative site can be selected and approved of by the Stormwater Technical Team without greatly affecting the implementation of the FSP.

If the primary issue is that a sediment trap cannot be installed, the high volume water filtering alternate technique could be employed at these sites without need for moving to alternate locations.

4.3.2 Industrial Sampling Sites

If it is not feasible to install the sampling equipment at an industrial sampling site, the same procedure described above for ~~land use-based~~ sites would be employed by moving ~~up~~ the pipe up or to another site drainage basin to see if another sampling point that drains most of the desired site can be found. If such an on-site alternate location cannot be found, it may or may not be feasible to select another industrial site to fulfill the role of the desired site. Any such proposals to move sites would be closely coordinated with the Stormwater Technical Team to obtain approval.

It is difficult to speculate what problems may occur and what the solutions may be without the basic reconnaissance of the sites completed. Consequently, we do not attempt to discuss alternate procedures for all potential situations. In general, if an ~~ISCO~~ ISCO sampler cannot be installed for any reason and selection of an alternate site is not acceptable, the alternate approach of manually collecting discrete or manual composites could be considered. If a sediment trap cannot be installed, high volume filtered sampling could be conducted.

4.3.3 Inadequate Sediment Collection

The sediment generation rate varies by land use, topography, implementation of best management practices (BMPs), and rainfall intensity. A well swept, nearly level, industrial area may not generate a significant quantity of sediment. Low intensity storms may not detach and mobilize sediments. ~~Further, S~~ sediment traps may not collect sediments from low flow storm events. Consequently, if the collection bottle is less than one-third full at the first monthly inspection, the rainfall records will be evaluated to determine if there were storms likely to generate runoff, the sampler will be inspected to ensure that it was installed properly, the ~~junction catch basin~~ will be inspected to see if it is accumulating sediment, and the contributing basin will be visually surveyed to see if sediment is available to wash off. Based on the findings, it may be recommended that the sediment trap be repositioned or relocated to obtain better collection rate, additional bottles deployed, or that another sampling method be employed. An alternative sediment sampling method would be high volume filtered samples.

4.4 SITE SPECIFIC SAMPLING ~~ADDENDUM~~ REPORTS

~~A site specific sampling reports addendum will be developed for added to the field sampling report (described in Section 5) based on the this FSP once the field reconnaissance surveys and decisions made in coordination with the Stormwater Technical Team, has been completed and the equipment has been installed.~~ A

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description of each sampling site will be developed for the report that describes the specific details for implementation of this FSP at the each site. The specific details will include:

1. Figure showing the drainage basin and actual sampling location within the basin.
2. The reconnaissance survey datasheets, notes, and photographs as necessary to describe the situation.
3. Diagram of sample equipment set up within the specific site pipe ~~catch basin~~, or junction noting key dimensions.
4. Photographs of the installation.
5. Calculations of estimated runoff quantity and responses for various ranges of storms for sampler programming.
6. Key parameters for sampler programming (i.e., number and size of bottles, sampling rate for various storm totals, enabling flow rate, trigger conditions, length of pickup tube, etc.).
7. Sample team leader responsible for sampler.
8. Sampler telephone number.
9. Any site specific considerations that will result in deviations from the FSP standard procedures.
10. Descriptions of any planned deviations from detailed procedures in this FSP including appendices that will be applied to this site.
11. Alternate or contingency procedures (as discussed above) that are proposed for that site.

4.5 PROJECT SCHEDULE

The actual start dates for the sampling will be determined following EPA approval of this Stormwater FSP. Other conditions that may affect the sampling schedule are weather and equipment conditions and availability. Currently, it is anticipated that the stormwater and sediment samples will be begin to be collected in late February through early March. Figure 4-~~32~~ shows the currently projected schedule. The most critical item beyond EPA approval is the acquisition and deployment of the water samplers. There is a 3 to 6 week lead time to acquire all the equipment. It is anticipated that each sampling crew will be able to install two sampling kits per day. Consequently, it will take approximately 4 to 7 weeks to deploy the first sampler from the time that it is ordered and approximately 8 weeks from the time the samplers are ordered for all of them to be deployed.

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The automated samplers will be activated as soon as they are installed to record flow rates and will be enabled to collect samples during the first storm event that exceeds the predetermined precipitation conditions. The sediment traps will also begin functioning as soon as they are installed. While flow is present in the stormwater system the samplers will be trapping sediments. Based on the weather forecasts and anticipated precipitation, sampling teams will be notified to enable the samplers and deployed to collect samples during following the storm events. Additionally, the sampling teams will be deployed based on forecasted weather to collect grab samples from selected locations.

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5.0 REPORTING

5.1 LABORATORY AND CHEMICAL DATA

Preliminary data obtained from the laboratory will be validated following the QAPP and QAPP Addendum procedures. These data will then be entered into the LWG database including any laboratory or validation assigned qualifiers. Validated analytical laboratory data from the LWG database will be provided to EPA in an electronic format within 90 days of completion of each sampling event. A sampling event will generally be considered complete when the last sample of that type described in this FSP has been collected.

5.2 FIELD MEASUREMENT DATA

Results of field parameters (e.g., pH) and flow data measurements at each location will be provided to EPA on schedule with and as a part of the Stormwater Site Characterization Summary Report described in Section 5.3. Field parameters will be validated consistent with the QAPP and QAPP Addendum procedures. Flow data results will be compiled into a separate project database. Rainfall data from publicly available area rain gauges will also be obtained and entered into the flow database.

Initially, these data will be reviewed against information obtained on the flow conditions and monitoring history at each site (e.g., structure and sensor placement issues, the presence of base flows, periods of known equipment malfunction) to identify and flag any periods of questionable or censored data. Data will also be reviewed for any questionable data in periods not associated with any of the above known issues and flagged accordingly (e.g., periods of very high recorded flow with no rainfall, highly erratic readings in small periods of time, periods of no flow during high intensity rain fall, etc.). Periods associated with chemistry sample collection will be identified and flagged within the database as well.

5.2.3 REPORTING

A Field Sampling Report will be prepared and submitted to EPA within 60 days of completing all stormwater and sediment field sample collection efforts as described in this FSP. The Field Sampling Report will summarize field sampling activities, including sampling locations (i.e., information described in Section 4.4 maps), requested sample analyses, sample collection methods, and any deviations from the FSP.

Stormwater and sediment chemistry results, field measurements, and storm flow data will be reported in tabular format in a Stormwater Site Characterization Summary Report that will be submitted to EPA within 120 days of completing sampling and analysis for all stormwater activities. The report will also include summaries of weather conditions (e.g.,

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field observations), field observations associated with each location inspection and/or sampling event, and rain gauge data throughout the sampled period. Preliminary Stormwater and other information and data evaluations relevant to the objectives of the study also will be included in the Stormwater Site Characterization Summary Report. However, the report will not include annualized loading estimates for use in modeling evaluations. This information will be developed and reported within the framework of the overall fate and transport modeling and data evaluations for the RI/FS.

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